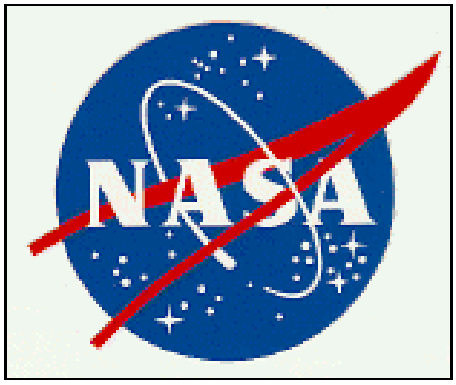
National Aeronautics and Space Administration
Office of Equal Opportunity Programs
Minority University Research and Education Division
Washington, DC 20546-0001

NRA 98-OEOP-1
Issued: July 24, 1997
Proposal Due: October 21, 1997

Faculty Awards for Research (FAR)



NASA Research Announcement (NRA)

Internet location: http://mured.gsfc.nasa.gov/pub/index.html

INQUIRIES

General questions about this NASA Research Announcement may be directed to the NASA Minority University Research and Education Division staff by contacting the below individuals:

Mr. John Malone
Minority University Program Specialist
NASA Headquarters
Code EU
300 E Street, SW
Washington, DC 20546

Telephone: (202) 358-0948
Fax: (202) 358-3745
Email: jmalone@hq.nasa.gov

or

Ms. Bettie L. White
Director, Minority University Research
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Email: bwhite@hq.nasa.gov

NASA Research Announcement
Faculty Awards for Research (FAR)

This NASA Research Announcement (NRA) solicits basic and applied research and analysis from faculty of Historically Black Colleges and Universities (HBCU) and Other Minority Universities (OMU), including Hispanic-Serving Institutions (HSI) and Tribal Colleges, which are relevant to one or more of the four NASA Strategic Enterprises described in the NASA Strategic Plan. The Strategic Enterprises are: Mission to Planet Earth; Aeronautics and Space Transportation Technology; Human Exploration and Development of Space; and Space Science. These Strategic Enterprises encompass a broad range of traditional science and engineering disciplines as applied to meeting NASA's mission needs. A detailed description of research opportunities that are relevant to research programs conducted at NASA Installations and the Jet Propulsion Laboratory (JPL) are given in Appendix A.

This solicitation is responsive to Federal mandates that require NASA to "...promote increased participation in Federal procurement by HBCU's and OMU's," including Hispanic-Serving Institutions (HSI) and Tribal Colleges (TC).

Participation in this program is open to tenure-track faculty of HBCU's and OMU's which offer degrees in engineering, mathematics, or science disciplines. Proposals which demonstrate effective partnerships or cooperative arrangements among government, academia, and industry will also be considered. Approximately 20 awards will be made based on merit reviews. Each award will consist of an annual grant, for a maximum of three years in support of the proposed educational research activities. NASA funding beyond the first year is based on an annual evaluation of documented progress, the availability of funds and the amount of funds reported in the Agency's Financial and Contractual Status (FACS) Report as unexpended at the end of the award's period of performance. **Proposals are due by 4:30 pm (EST) October 21, 1997. Any proposals received after that time, will not be accepted.**

Your interest and participation in this Minority University Research and Education Program and the Faculty Awards for Research Announcement are appreciated.

George E. Reese
Associate Administrator for
Equal Opportunity Programs

FACULTY AWARDS FOR RESEARCH

Faculty Awards for Research

I. Program Description

Overview

In response to a congressional mandate to increase diversity in the pool of Agency researchers, NASA's Office of Equal Opportunity Programs invites proposals for the NASA Faculty Awards for Research (FAR) Program.

During Fiscal Year (FY) 1998, approximately 20 proposals indicating research areas relevant to the NASA Strategic Enterprises will be selected from HBCU's and OMU's (which include HSI's and TC's). These universities are specifically targeted for two purposes - - to enhance cultural diversity in the NASA-sponsored research community, and to assist the Agency in building a workforce that includes those individuals who have been traditionally underrepresented in science and engineering research careers. Universities should encourage outstanding and promising faculty, who have received a total of $250,000 or less in NASA research grants during the last 5 years, to submit a proposal.

Tenure-track faculty employed at eligible HBCU's and OMU's are invited to apply. Approximately 10 awards will be made to HBCU faculty and 10 awards to OMU faculty. Awards in support of the planned research activities will be made for up to 3 years based on an evaluation of documented progress, the availability of funds and the amount of funds reported in the Agency's Financial and Contractual Status (FACS) Report as unexpended at the end of the award's period of performance.

As a result of participating in this program, principal investigators will contribute directly to NASA research and support the development of socially and economically disadvantaged and disabled student researchers. Opportunities for participation in the Agency's mainstream research will expand as recipients' research capabilities are enhanced through interaction with NASA researchers and facilities. The student researchers will gain meaningful research experience by participating in the FAR program and their interest in pursuing advanced degrees in science, engineering and mathematics will increase. Furthermore, as the students graduate, the employment pool will increase for those historically underrepresented in the science, engineering, and technology fields.

Goals and Objectives

The goal of this program is to enhance cultural diversity in the NASA-sponsored research community by supporting faculty and students at HBCU's and OMU's while achieving NASA's mission.

Program objectives to accomplish this goal are as follows:

- Identify outstanding and promising engineering, physical and life science tenure-track faculty early in their academic careers as principal investigators who are capable of contributing to the Agency's research objectives and who have limited past NASA research grant experience.

- Provide such faculty members with sufficient research support and exposure to the NASA peer review process to enable them to demonstrate creativity, productivity, and future promise in the transition toward achieving competitive awards in the Agency's mainstream research processes.

- Support these investigators with resources to provide research experience in NASA-related fields to graduate and undergraduate students, who are U.S. citizens, thereby increasing the pool from which NASA and the aerospace industry can draw.

Support and Commitment to the FAR Program

NASA

Approximately 20 awards will be made based on merit reviews. Each award will consist of an annual grant of no more than $100,000 per year for up to 3 years in support of the proposed research activities. A minimum of 25 percent of the NASA funds each year must go to support for U.S. citizen graduate and undergraduate students involved with the research project. NASA funding beyond the first year is contingent upon the submission of a satisfactory annual performance report, submission of appropriate accounting forms, and the availability of funds.

Universities

Universities should clearly and succinctly identify any significant resources and support of their faculty principal investigators. Applicants who are principal investigators or co-investigators on other current or pending grants from NASA or other funding agencies should clearly identify such grants and explain in detail how the work and funding from the various sources will complement each other.

Principal Investigators

Principal investigators (PI) must maintain their status as full-time, tenure-track faculty members. The proposed research is to be conducted primarily at the university or at any institution or facility engaged in substantial NASA research.

Principal investigators are encouraged to coordinate their research with a NASA Field Installation or JPL. They must also involve socially and economically disadvantaged and/or disabled graduate and undergraduate students who are U.S. citizens in their

research. The research funding may include support of research assistants, undergraduate student researchers, professional travel, research supplies and equipment, PI summer salary, and release time for conducting research.

II. General Information about the FAR Solicitation

Eligibility Requirements

Universities

All proposals must originate from U. S. colleges or universities that meet the following criteria. Proposing institutions must:

a. Offer degrees in engineering, mathematics or science disciplines **and**

b. Meet at least one of the following criteria:

Must be an accredited minority college or university with enrollment of a single underrepresented minority group or the combination of underrepresented minority groups that exceeds 50 percent of the total student enrollment as defined in the *Higher Education Act* as amended [see 20 USC 1135d-5 and 34 CFR 637.4(b)]; **and/or**

Must be designated by the Department of Education in FY 1994 as a Hispanic-Serving Institution (HSI) under Title III of the *Higher Education Act of 1965*, as amended [See 20 USC 1059 ©; Public Law 102-325, Section 316, July 22, 1992]; **and/or**

Must be designated by the Department of Education as a Historically Black College or University under Title III of the *Higher Education Act of 1965*, as amended (see 34 CFR 608.2); **and/or**

Tribal colleges and universities must be cited in Section 532 of the Equity in Educational Land-Grant Status October of 1994; Tribally Controlled Community College Assistance Act of 1978; or the Navajo Community College Assistance Act of 1978, Public Law 95-471.

Principal Investigators

Principal investigators must meet all of the following criteria at the time the proposal is submitted:

Must be a tenure-track faculty member of an eligible institution.

Must have a Ph.D. in an engineering, mathematics or science discipline applicable to NASA research needs. Must be a U.S. citizen (citizenship will be verified at the time of the award). May not be a former and/or current FAR recipient.

Received no more than $250,000 in NASA research awards during the last 5 years. Applicants who are current/former principal investigators or co-investigators on NASA research awards must identify the amount of funding from such awards which support or have supported their part of the research.

NOTE: Co-Investigators are not permitted.

Solicitation Availability

A copy of the solicitation and the forms are available electronically via the Internet at the following address:

http://mured.gsfc.nasa.gov/pub/index.html

Schedule

NASA Research Announcement Released	July 24, 1997
Proposals Due	October 21, 1997
Selection Announcement	December, 1997

Contact for Questions

If you have any questions pertaining to this solicitation you may contact:

Mr. John E. Malone
NRA 98-OEOP-1
NASA Headquarters
Code EU
Washington, DC 20546-0001
Telephone: (202) 358-0948
Fax: (202) 358-3745
email: john.malone@hq.nasa.gov

III. Proposal Guidelines, Preparation Instructions, and Proposal Submission

Amendatory Guidelines Applicable to NRA 98-OEOP-1

General guidelines for proposal preparation are given in Appendix B, "Guidelines for Responding to NASA Research Announcements for Solicited Basic Research Proposals." However, certain sections listed in Appendix B must be appropriately modified to meet the intent of the FAR program. For convenience, the following sections augment the descriptions in Appendix B.

A. Proposal Guidelines

1. If substantial collaborations with other institutions are intended, letters of endorsement must be submitted by the responsible individuals from those institutions in an appendix. Each endorsement letter should indicate agreement with the nature of the collaboration detailed in the proposal which should be identified by title and date of submission.
2. All proposals must originate from a U.S. university or college which meets the designated criteria and must reflect the unique combination of the applicant's interests and capabilities. The proposal should clearly identify the relevance of the research to NASA's mission. Written eligibility certification must be submitted for both the university and the PI. (See Form C-3)
3. The "Length" section of Appendix B (Section 9) is modified to require that the proposal's investigation description be limited to 10 pages. Reviewers will be instructed and obligated to review only the first 10 pages of the description.
4. A total of four copies, numbered 1 through 4, must be received by the appropriate NASA Installation or JPL by the deadline specified. A submitted proposal should be no more than 35 pages in length, using standard-sized paper (8.5"x11"), one-inch margins (top, bottom, left and right), and 12-point font. Certifications, appendices, forms, and figures, e.g., depicting research schedule, are desired but must fit within the 35-page limit. If a proposal is submitted printed double-sided, only 18 sheets of paper are acceptable, still totaling 35 printed pages. To facilitate the recycling of proposals after review, proposals should be submitted on plain, white paper only. The use of cardboard stock, plastic covers, colored paper, etc., is prohibited.

B. Budget Guidelines

The "Proposed Costs" discussed in Section 7.8 of Appendix B is supplemented by the following information concerning proposal cost detail.

1. The proposal should contain sufficient cost detail and supporting information to facilitate a speedy evaluation and award. Dollar amounts proposed with no explanation (e.g., Equipment: $5,000, or Labor: $23,000) may cause delays in funding should the proposal be selected. The proposed costing information should be sufficiently detailed to allow the Government to identify cost elements for evaluation purposes. Generally,

the Government will evaluate costs in terms of their reasonableness and acceptability. Each category should be explained. Offerors should exercise prudent judgment since the amount of detail necessary varies with the complexity of the proposal.

2. Direct labor costs should be separated by titles or disciplines such as Principal Investigator, clerical support, with percent of time. Estimates should include a basis of estimates such as currently paid rates or outstanding offers to prospective employees. Indirect costs should be explained to the extent that allows the Government to understand the basis of the estimates.
3. With regard to other costs, each significant category should be detailed, explained, and substantiated. For example, proposed equipment purchases should specify the type of equipment, number of units, and unit cost. Requested travel allowances should include the number of trips, duration of each trip, air fare, per diem, rental car expenses, etc.
4. Indirect costs are included in the $100,000.

C. Proposal Evaluation

Proposals will be evaluated on the six criteria listed below. They are listed in descending order of importance.

1. *Technical Soundness* (30 points). Quality and approach of the proposed research, and its relevance to the NASA Installation or JPL research topic, overall project design, and thoroughness of research, evaluation and transition plans.
2. *Performance Competence* (20 points). Qualifications of faculty principal investigator. Evidence of the researcher's skills, experience, and past accomplishments, and plan for participating in NASA mainstream research program.
3. *Growth Potential* (15 points). Degree to which the proposed research will meet the NASA objective to develop a pool of bachelors and graduate degree recipients, who are U.S. citizens and socially and economically disadvantaged or disabled with research experience in NASA-related fields. Feasibility of proposed plan to track students involved in this research project through completion of their degree.
4. *University Commitment* (15 points). Evidence of adequacy of institutional resources available and university long-term commitment of resources, staffing, computer, equipment, and facilities.
5. *Degrees* (10 points). Degree awards to disadvantaged and disabled students. Provide the total number of bachelor, master, and Ph.D. degrees awarded and the total number and percent of bachelor, master, and Ph.D. degrees awarded to disadvantaged and disabled students from the school submitting the research proposal for Academic Year 1996-1997.
6. *Cost* (10 points). Appropriateness of the budget, including reasonableness of proposed cost and cost elements, cost-sharing, and the relationship of the proposed cost to available funds.

D. Selecting Your Designated Research Area

Applicants may propose to conduct research in an engineering or a science discipline which supports NASA's Strategic Enterprises and is related to NASA's mission. A list of such research opportunities that are relevant to the NASA Installations and the JPL are given in Appendix A.

A principal investigator may submit only one proposal but may submit it to more than one Installation or JPL for consideration. However, the selection of **only one research topic per Installation/JPL is allowed.** Please indicate the topic selection on the proposal cover page (Form C-1).

Discussions of proposed research with appropriate NASA Field Installation or JPL personnel before submission of a proposal to that Installation or JPL is strongly encouraged. A list of appropriate initial NASA Installation and JPL contacts is given below

E. Contact List for NASA Installations and JPL

Ames Research Center
Mr. Geoffrey Lee
(415) 604-6406
Fax: (415) 604-3869

Dryden Flight Research Center
Ms. Erma Cox
(805) 258-3033
Fax: (805) 258-2800

Goddard Space Flight Center
Dr. Dillard Menchan
(301) 286-7348
Fax: (301) 286-0298

Jet Propulsion Laboratory
Mr. Richard Ashe
(818) 354-3014
Fax: (818) 393-4977

Johnson Space Center
Dr. Joseph D. Atkinson
(713) 483-4831
Fax: (713) 483-4876

Kennedy Space Center
Ms. Evelyn Johnson
(407) 867-9834
Fax: (407) 867-1066

Langley Research Center
Dr. Samuel E. Massenberg
(804) 864-5800
Fax: (804) 864-6521

Lewis Research Center
Mr. Robert Lawrence
(216) 433-2921
Fax: (216) 433-5266

Marshall Space Flight Center
Mr. Willie Love
(205) 544-0088
Fax: (205) 544-2411

Stennis Space Center
Dr. Armond Joyce
(601) 688-3830
Fax: (601) 688-7499

F. Proposal Format, Content, and Page Limitation

The proposal should be submitted according to the order listed below and should not exceed 35 pages including certifications, forms, and appendices. Each proposal should adhere to the table guidelines for the maximum number of pages for that section.

	Proposal Requirements	Max. Pages	Comments
Transmittal Letters	1. Transmittal Letter	1	
	2. University Statement A description of the university's support and resource commitments.	1	
Required Forms	3. FAR Proposal Cover Page The proposal cover sheet must be signed by an institutional official who is authorized to certify institutional support and sponsorship of the investigation and of the management of the proposal.	1	Appendix C Form C-1
	4. Table of Contents	1	
	5. Certification of Institution and Faculty Eligibility Form	2	Appendix C Form C-2
	6. Supplementary Information Report Form (optional)	1	Appendix C Form C-3
	7. Certifications Regarding Lobbying, Debarment, Suspension and Other Responsibility Matters and Drug-Free Workplace Requirements Form Each proposal must be accompanied by these institutional certifications expressing compliance with Federal regulations.	2	Appendix C Form C-4
	8. FAR Enrollments and Degrees Awarded Academic Year 1996-1997 Form	1	Appendix C Form C-5

	Proposal Requirements	Max. Pages	Comments
	Statistics for the school submitting research proposal.		
	9. Proposal Summary Form Include an abstract (200-300 words) of proposed research describing the objectives and method of approach. Include how the research relates to NASA interests and major accomplishments planned for the performance period.	2	Appendix C Form C-6
Project Description	10. Proposal Investigation Description Narrative should include the PI's research, evaluation, and transition plans. Plans should include objectives that are specific, measurable, achievable, and realistic within a stated time period. Include a detailed plan describing involvement in the research of socially and economically disadvantaged and disabled graduate and undergraduate students who are U.S. citizens. Detail how these students will be tracked through completion of their degrees.	10	Appendix B Section 7.4
Qualifications	11. Principal Investigator Research Qualifications Submit proposer's vitae, including academic record and listing of relevant publications. A single-page bibliography including no more than five publications relevant to the proposed research may be included as an appendix.	3	

	Proposal Requirements	Max. Pages	Comments
Budget	12. Budget Narrative Include explanatory notes for each line item in the budget. Funding limitation of $100,000 **includes** indirect costs. 13. FAR Budget Form Summary budget by year and cost element for all 3 years. A minimum of 25 percent of the total budget must directly support socially and economically disadvantaged and/or disabled graduate and undergraduate students who are U.S. citizens. No single student may receive more than $15,000 per year. Student support should be categorized under the "Other Costs," Section 2.f of the Budget Form.	6	Appendix C Form C-7
Appendices	Σ Endorsement Letters Σ Single-Page Bibliography		

Note: Proposal must not exceed 35 pages, including certifications, forms, and appendices.

G. Proposal Submission

All proposals must be ***received at the appropriate NASA Installation or JPL no later than 4:30 p.m. (local time), Tuesday, October 21, 1997,*** to be considered for this year's awards. This supercedes Number 11 of Part 18-70 NASA Federal Acquisition Regulation Supplement listed in Appendix B.

The proposals may be delivered by regular mail, certified mail, or commercial delivery. Avoid using registered mail, as this may delay the log-in time of arrival. To ensure identification of proposals by the mailrooms for proposals sent through regular U.S. mail, please mark your proposal in an appropriate place with the following identifier in large bold letters: "FAR PROPOSAL - NRA 98-OEOP-1."

Receipt acknowledgment by the appropriate NASA Installation or JPL will be mailed within 14 calendar days of the proposal's due date.

Number of copies to submit to both NASA Headquarters and the selected NASA Installation are listed below:

A. Headquarters

Two copies of the proposal must be sent to Mr. John Malone at the following address:

U.S. Mail:
Mr. John E. Malone
NRA 98-OEOP-1
NASA Headquarters
Code EU
Washington, DC 20546-0001

Commercial delivery (e.g., Federal Express) or hand-carried to:
Mr. John E. Malone
NRA 98-OEOP-1
NASA Headquarters
Attn: Receiving and Inspection (rear of building)
Code EU
300 E Street, SW
Washington, DC 20546-3210

and;

B. NASA Field Installations and JPL

An original and three copies of the proposal must be sent to the appropriate NASA Field Installation or JPL that is responsible for the proposed topic area. (If you are submitting to more than one Installation, an original and three copies of the proposal must be sent to each site). The following is a list of mailing addresses for the NASA Installations/JPL.

Proposal Mailing Address For NASA Installations and JPL

Ames Research Center
Ames Research Center
c/o Mr. Geoffrey Lee
NRA 98-OEOP-1
Mail Stop 223-3
Building N 223, Room 113
Moffett Field, CA 94035-1000

Dryden Flight Research Center
Attn: Ms. Erma Cox/D-1030
Dryden Flight Research Center
NRA 98-OEOP-1
4876 Lily Drive
Edwards, CA 93523-00273

Goddard Space Flight Center
Attn: Ms. Gwennie Durrah
For Mr. Dillard Menchan
Goddard Space Flight Center
NRA 98-OEOP-1, Mailroom
Mail Code 239
Greenbelt, MD 20771

Jet Propulsion Laboratory
Mr. Richard Ashe, Jr.
Administrator, Minority Science
& Engineering Initiatives Office
Jet Propulsion Laboratory
NRA 98-OEOP-1, MS 72-109
4800 Oak Grove Drive
Pasadena, CA 91109

Johnson Space Center
Dr. Joseph D. Atkinson, Jr.
Director, Minority Research
and Education Program
Johnson Space Center
FAR Proposal, NRA 98-OEOP-1
2101 NASA Road One
Mail Code AP2
Houston, TX 77058-3696

Kennedy Space Center
Kennedy Space Center
NRA 98-OEOP-1
Mail Code OP-CIAO
Kennedy Space Center, FL 32899

Kennedy Space Center (cont'd)
For Commercial Delivery:
Attn: Ms. Evelyn Johnson
NRA 98-OEOP-1
State Road 3 (Gate 2)
Building N6-1009
Kennedy Space Center, FL 32899

Langley Research Center
Grants Office
NRA 98-OEOP-1
Langley Research Center
MS 126, Building 1195A R215
9A Langley Boulevard
Hampton, VA 23681-0001

Lewis Research Center
Attn: Mr. Robert Lawrence
Lewis Research Center
NRA 98-OEOP-1
Mail Stop MS 3-16
21000 Brookpark Road
Cleveland, OH 44135

Marshall Space Flight Center
Attn: Ms. Marena McClure
Procurement Office
Marshall Space Flight Center
NRA 98-OEOP-1
Mail Code GP10
Marshall Space Flight Center, AL 35812

Stennis Space Center
Attn: Mr. Frank Oerting
Stennis Space Center
NASA Procurement Office
NRA 98-OEOP-1
Mail Code DA00
Stennis Space Center, MS 39529

IV. Selection and Notification

The NASA FAR program is highly competitive. By reading the entire solicitation document and then carefully following the instructions, you will avoid the problem of having your proposal disqualified for failure to meet basic requirements. NASA has no obligation to evaluate proposals that do not meet all stated requirements.

Proposals will go through a competitive review process. Award announcements will be made in December 1997.

The selection official for this solicitation is the Associate Administrator for Equal Opportunity Programs.

V. APPENDICES

Appendix A

Description of FAR Research Opportunities

Ames Research Center (ARC)

Aerophysics **AR01**

Aerodynamics: applied aerodynamics, advanced aerodynamic concepts, aerodynamic facilities and operations. Computer systems and research: systems integration. Fluid Dynamics: computational aerosciences, computational algorithms and applications, turbulence and transition, modeling and experimental validation, fluid mechanics. Numerical Aerodynamic simulation Systems: applied research, systems development, computational programs.

Aerospace Systems **AR02**

Full-Scale Aerodynamics Research: fixed wing aerodynamics; rotorcraft mechanics; National Full-Scale Aerodynamics Complex (NFAC), the world's largest wind tunnel; data acquisition, systems and research operations. Information Sciences; artificial intelligence, computational systems, spacecraft data systems. Human Factor Research: computational human engineering; full-mission simulation, human interface research, rotorcraft human factors, flight human factors. Flight Systems and Simulation: air traffic control, field systems, flight dynamics and control; simulations experiments, aircraft systems, aircraft guidance and navigation, simulation systems.

Airborne Science and Applications **AR03**

Develop instruments and conduct airborne experiments in Earth systems science and airborne astronomy utilizing unique high altitude (ER-2) and medium altitude (DC-8, C-130, Learjet) airborne facilities for remote-sensing and in-situ Earth studies. Analyze and archive acquired airborne science data. Develop sensors and perform ground-based infrared astronomical observations and data reduction and analysis.

Ecosystem Science and Technology **AR04**

Interdisciplinary research which looks at the role of life in modulating the complex cycling of materials and energy throughout the biosphere. Intact ecosystems, with particular emphasis on temperate and tropical forests, are examined by remote-sensing from aircraft and spacecraft and by field site visits, with subsequent laboratory and computer analysis of the data gathered.

Flight Research **AR05**

Flight test, modification and maintenance of powered-lift aircraft and rotorcraft. Development and evaluation of ground-based flight simulators. Management and operation of aeronautical test range for research aircraft tracking and data analysis.

Space Research **AR06**

Life Sciences: gravitational biology, flight equipment engineering, science operations, payload operations. *Earth System Science:* ecosystem science and technology, atmospheric chemistry and dynamics, atmospheric physics. *Space Science:* observational astrophysics, laboratory astrophysics, planetary science, exobiology, star and planet formation, search for other planetary systems, planetary exploration.

Advanced Space Technology: extra-vehicular life support systems, regenerative life support systems, hypersonics, aerothermodynamics, computational chemistry, thermal protection systems, and facilities, infrared detector development, cryo-optics, systems evaluation and integration. *Space Projects:* centrifuge facility project, gravitational biology project, stratospheric observatory for infrared astronomy project, Discovery project development, unpiloted research aircraft development, advanced mission studies.

NASA has designated Ames Research Center as the Center of Excellence for Information Technology (COE-IT), specifically, to pioneer and lead the research development, and implementation of information technologies to support NASA's Aeronautics and Space Enterprises and missions. Its five information technology focus areas are identified as follows:

Integrated Design Systems: Intelligent computational tools and modeling methods; System Integration tools and data bases; Infrastructure for collaborative computing; and, Immersive design environments.

Large-Scale Information Management and Simulation: Data archiving and dissemination; information discovery and utilization; and, Knowledge creation.

Aviation Operations: Information management; Intelligent decision support agents; Human factors; and Software engineering for ultrareliability.

Space Systems Operations: Automated fault/health management advisory tools; design/operations data bases; and telescience, remote presence, and virtual environment Interfaces.

Autonomous Systems for Space Flight: On-board fault detection, analysis, isolation, and recovery; Closed-loop event detection and response; and Management and control of Interacting heterogeneous Intelligent agents.

Dryden Flight Research Center (DFRC)

Flight Operations **DF01**

High speed/performance mission support, shuttle landing support, avionics, flight crew, aircraft life support, operations engineering, aircraft quality inspection, aircraft maintenance and modification, flight data acquisition systems, and mission control.

Research Engineering **DF02**

Fluid and flight mechanics, aerostructures, thermostructures, propulsion and performance, flight instrumentation, flight dynamics, flight controls and systems, structural dynamics, thermal and mechanical load control systems, ground test data acquisition systems, and sensor evaluations.

Research Facilities **DF03**

Information systems, range systems, flight simulation systems, integrated test systems, systems development, system integration and facilities engineering.

Goddard Space Flight Center (GSFC)

Space Sciences **GS01**

High energy astrophysics; X-ray and gamma-ray spectroscopy, cosmic ray physics; solar, stellar, galactic and metagalactic high energy processes; UV, optical, and infrared astronomy; theoretical astrophysics; cosmic background radiation; solar physics; radio galaxies; chemical history of solar system; solar wind; comets; planetary atmospheres, magnetospheres, meteoritic asteroids, radio wave and ion

plasma of planetary satellites; galactic, stellar, and planetary infrared spectroscopy; molecular aeronomy; extreme UV spectroscopy, planetary electric and magnetic fields.

Earth Sciences **GS02**

Earth system sciences integrates the search for understanding the way the Earth System works including interactions among the atmosphere, hydrosphere, biosphere, and the solid Earth. This involves numerical modeling of the atmosphere, ocean, and terrestrial systems; supporting observational studies on radiation, vegetation, tropospheric and stratospheric chemistry, ocean surface dynamics, sea ice, oceanic productivity, regional and micro-scale dynamics, cloud convection, cloud modeling and radiation balance, solar radiation studies, geophysics, plate tectonics, geomagnetism, gravity, celestial dynamics, and planetary atmospheres. Tools used to provide observations supporting these studies include remote-sensing, passive and active instruments including laser and radar altimetry, scatterometry and microwave sensors. Data interpretation methods include data assimilation into models. Field studies are also carried out, involving in-situ sensors, aircraft and satellite sensors.

Engineering Development **GS03**

Optical analysis, optical material research and optical metrology equipment development; thermal analysis including two-phase heat transfer, contamination effects and contamination transport mechanisms applied to advanced spacecraft and instrument systems for STS and free-flying spacecraft; cryogenic cooling development for space instruments; very large-scale integrated circuits using NMOS and CMOS; multi-chip module radiation-hardened processors, high density solid state memories, and fiber optic data networks, advanced electronic and photonic materials and microelectronic device fabrication; ultra-low noise microwave amplifier and mixer design and testing; correlated double sampling of infrared detector array data; advanced sensors and instruments for observation of x-ray, gammma-ray and ultraviolet radiation, images, and spectroscopy; electromechanical subsystem control, interactions, system modeling, and developing control laws for small self-contained instruments; vibration cancellation and isolation; analysis of the dynamics of large structures in orbit, flexible space structures, thermal effects, excitation by mechanisms or spacecraft control system; attitude dynamics and control of spinning / non-spinning flexible spacecraft and, dynamics and precision-pointing of instruments from zero momentum 3-axis controlled spacecraft.

Communications & Data Systems Development **GS04**

Expert systems / neural networks / model-based systems / agent-based systems for automated mission operations, resource scheduling, and system and network modeling and fault isolation; distributed systems for payload control and data handling; VLSI and gate array design for real-time telemetry processing; software engineering technology for decentralized development of large scale systems and development of a reusable software base; data management technology for distributed systems and data flow architectures for telemetry processing; human factors technology and rapid prototyping techniques for interactive spacecraft, network, data system control workstation design, and RF communications, modulation / coding, antennas, receivers, demodulators, and propagation effects.

Computational Sciences and Information Systems **GS05**

Simulations and modeling of Earth and space phenomena; high performance computing; global optimization algorithms and applications; simulated analogs; genetic algorithms; neural networks; intelligent data management systems; mass data storage systems, access and retrieval; scientific visualization and animation; voice recognition, data compression, optical systems characterization, image restoration, and on-board high performance data recorders.

Earth Sciences **GS06**

Earth system sciences integrates the search for understanding the way the Earth System works including interactions among the atmosphere, hydrosphere, biosphere, and the solid Earth. This involves numerical modeling of the atmosphere, ocean, and terrestrial systems; supporting observational studies on vegetation, tropospheric and stratospheric chemistry, ocean surface dynamics, sea ice, oceanic productivity, regional and micro-scale dynamics, cloud convection, cloud modeling and radiation balance, solar radiation studies, geophysics, plate tectonics, geomagnetism, gravity, celestial dynamics, and planetary atmospheres. Tools used to provide observations supporting these studies include remote-sensing passive and active instruments including laser instruments including laser and radar altimetry, scatterometry, and microwave sensors. Data interpretation methods include data assimilation into models. Field studies are also carried out, involving in-situ sensors, aircraft and satellite sensors.

Research Opportunities at Wallops Flight Facility **GS07**

Physical oceanography, laser remote-sensing applications, atmospheric chemistry, remote-sensing of atmospheric ozone, development of remote sensors, thin film material research, balloon membrane structural analysis, launch vehicle aero-ballistics, reentry, aero-thermal analysis, development of improved attitude control system(s), network and data systems control, thermodynamic modeling of large balloon structures, environmental impact of range operations.

Research Opportunities At Goddard Institute for Space Studies **GS08**

The Goddard Institute for Space Studies (GISS), located on the Columbia University campus in New York City, conducts comprehensive, theoretical and experimental research in: climate change, Earth observations, paleoclimatology, cloud climatology, radiation studies, hydrological studies, stratospheric dynamics biogeochemical cycles and planetary atmospheres including the dynamical meteorology of Mars. GISS is the Global Processing Center for the International Satellite Cloud Climatology project.

Jet Propulsion Laboratory (JPL)

Systems **JP01**

Systems analysis; policy analysis and operations research; design of space missions; spacecraft system design and concurrent engineering, integration; assembly, test and launch operations, navigation; spacecraft sequence design including robotics and artificial intelligence applications; mission operations systems; distributed real time information systems.

Earth and Space Sciences **JP02**

Emphasis on remote-sensing along with extensive efforts in data analysis and theoretical modeling, field measurements and laboratory research in related disciplines. Fields of interest are planetary atmospheres, planetary geology, planetary and interstellar astronomy, astrophysics, relativity and cosmology, interplanetary space physics, comet and asteroid studies, Earth atmosphere, atmospheric chemistry, global weather and climate, oceanography, geosciences, air-sea interaction, and air-land interaction.

Telecommunications Science and Engineering **JP03**

Emphasis on deep space and Earth satellite communications, radiometric tracking and active remote-sensing along with related science, technology, and engineering. Areas of current interest include: spacecraft communications systems, highly stable microwave transponders, low noise amplifiers, efficient antennas, source and channel coding, noise processes, signal processing, communication networks, ultra-precision frequency

standard systems, custom VLSI chips for communications, optical space communication systems, satellite-based mobile communication systems, high power Earth-based radar, spaceborne synthetic aperture radar, altimeters, meteorological radars, scatterometers, radar radiometrics, VLBI and GPS-based systems for navigation and tracking, geodynamics science and instrumentation, radio and optical interferometry.

Avionic Systems and Technology **JP04**

Advanced microelectronics including sensors, micromagnetic and superconducting devices, and microelectronic materials; in-situ microinstruments; analog processing devices, fuzzy logic, and neural networks; guidance and control analysis for advanced spacecraft including special topics information flight and tethered systems; sensor, actuator, and control development for spacecraft, a microspacecraft, and space structures; space interferometer technology; robotics, telerobotics, autonomous vehicles, and microrovers; telepresence and virtual reality; machine vision, photonics, including optical processing and electro-optics; machine intelligence and autonomous intelligent spacecraft, ground system, and mission operations technology; energy conversion, storage and management, including fuel cells, batteries, solar arrays, and thermal-to-electric converters, for spacecraft and terrestrial power systems; integrated microavionics technology and applications including concurrent, distributed processing, integrated power electronics, and advanced packaging; spacecraft data system technology including computer architecture, flight computers, data storage, and software.

Mechanical Systems Engineering and Research **JP05**

Active cooling of sensors, vibrational isolation of substructures, precision deployable space structures, precision inflatable structures, opto-electronic materials, dimensionally stable structures, smart structures and materials, active optics devices, electric propulsion, advanced chemical propulsion, cold electronics, advanced electronic packaging, low temperature physics, advanced chemical systems, miniaturized spacecraft components, advanced instrumentation, environmental simulation.

Observational Systems **JP06**

Development of instrumentation systems employing X-ray, ultraviolet, visible and infrared imaging; infrared and visible spectroscopy; passive microwave radiometry; and analytical techniques. Development of calibration science technology to enable quantitative remote-sensing. Technology development and characterization of advanced sensors and focal plane arrays. Development of optical systems, interferometry, electro-optical systems, and optics technology. Development of science data processing systems including algorithms and systems architectures, image processing and science data analysis and visualization. Development of science data management systems and analyzing systems.

Information Systems Development and Operations **JP07**

Development, planning and operations related to ground-based information systems for spacecraft missions. Research areas include: advanced automation for spacecraft diagnosis; simulation and graphics for knowledge fusion, data understanding, and training; high-rate, high-capacity information systems; software productivity and reliability; intelligent access to large, interactive hypermedia data bases; high-performance computing and networking; numerical analysis and computational software libraries; and low-cost mission operations.

Reliability Engineering **JP08**

Electrical interactions and environmental modeling, radiation caused electrostatic discharge, single event upsets, microelectronics parts reliability and packaging, dielectric breakdown, plasma models, high energy trapped radiation, cosmic ray models, planetary magnetospheres, high voltage interactions, reliability predictions, launch dynamic environment estimates and analysis, dynamic modeling and testing, thermal environment estimates and analysis, thermal modeling and testing.

Software Assurance **JP09**

General software engineering, software product assurance, software reliability, software metrics, formal methods, formal inspections, software safety, object-oriented development methods, requirement analysis, human-computer interfaces, casual analyses and command assurance.

Johnson Space Center (JSC)

Engineering Directorate

Crew and Thermal Systems Division **JS01**

Research and technology development in the areas of biological and physical/chemical regenerative life support systems and active thermal control systems for crewed spacecraft and surface bases; extravehicular individual life support systems; space suit systems, and protective system concepts for dust exclusion from extravehicular system hardware components.

Tracking and Communications Division **JS02**

Design and analysis of space communication and tracking systems. Topics of interest include: infrared, laser/optical millimeter wave, microstrip patch antennas, multibeam arrays, multiaccess, packetization, interference tolerance, channel coding, video compression, secure data, voice control, automated control and monitoring, and digital and Fourier optics vision.

Navigation, Control, and Aeronautics **JS03**

Design, development, integration, and testing of guidance, navigation, and control hardware and software systems for atmospheric and orbital flight; aerosciences engineering in the disciplines of flight dynamics, computational fluid dynamics, aerodynamics, and aerothermodynamics; application of Total Quality Management Tools to projects.

Flight Data Systems **JS04**

Study of flight data systems hardware and software which provides spacecraft computation and information processing, onboard check-out, instrumentation, data storage, and displays and controls. Includes applied technology studies for spacecraft data systems, instrumentation, signal conditioning, data recording, and advanced displays and controls.

Propulsion and Power **JS05**

Study of propellant chemistry and physics of combustion venting; fluid system leakage detection; cryo-coolers for long-term storage; high temperature rocket combustion chamber materials; propulsion/fluid system health monitoring; electric motors and controllers; zero/low gravity fluid management for Earth storable and cryogenic fluids; chemical reaction kinetics of pyro initiator explosions; evaluation of fuel cell polymer

and intercalation-type electrodes; development of software system designs for distribution, control, and management of electrical power for space systems.

Automation and Robotics **JS06**

The study of the application of Artificial Intelligence (AI) and advanced automation technologies to the areas of: system and subsystem monitoring, control and diagnosis; automated assistance for systems operations; process planning and scheduling; advanced systems analysis and control; computer-aided engineering; concurrent engineering and intelligent integration of information; massively parallel and distributed computer processing; automated knowledge acquisition and machine learning; object-oriented data bases and data mining; graph theory and knowledge representation; human-computer interaction; engineering methods for intelligent systems; teleoperator, telerobotic, and autonomous robotics control system development; robotic sensing, perception, and world model updating; real-time simulation of manipulators; engineering and integration of manipulators and end-effectors into laboratory robots.

Structures and Mechanics **JS07**

Study of microcracking of composite materials; study of spacecraft re-entry thermal protection and on-orbit thermal control techniques modal, vibration, and acoustic testing; and methods for micro-g isolation of on-orbit experiments, advanced methods for use in structural response analysis, and advanced computational computer-aided engineering graphics techniques for structural and thermal analysis.

Systems Engineering **JS08**

Research and development in the area of flight mechanics; conceptual design and analysis of evolutionary and future systems for transportation; Earth orbit activities.

Information Systems Office

Advanced Information Systems Technology **JS09**

Opportunities exist for developing and evaluating advanced information systems technology in support of NASA institutional and mission operations. Current areas include research into heterogeneous digital libraries, virtual reality technologies, general purpose intelligent training systems, expert assistants, neural networks for machine learning, applications of pattern recognition and signal processing to system monitoring and process control, software development tools and methods, network technology, genetic algorithms, distributed computing technology, and knowledge / process capture technology.

Safety, Reliability, and Quality Assurance Office **JS10**

Develop strategies for expanding the current methodologies in risk assessment. Investigation, assessment, evaluation and initial feasibility development of automated failure tolerance analysis program, FMEA programs, fault-tree generation programs, and system safety analysis programs. Develop software product assurance methodologies for very large scale systems, expert systems and certified intelligence systems, including verification and compliance with product assurance requirements. Develop on-orbit systems maintainability technology such as calibration and pressure systems recertification. Develop application of existing nondestructive evaluation (NDE) technology for on-orbit systems including leak detection, composite materials, stress distribution, and surface impact detection. Develop technology and methodology for early detection of system failures, contamination, fires, and leaks.

Space and Life Sciences Directorate

Life Sciences Project Division **JS11**

Investigation, assessment, evaluation and initial feasibility development of biomedical instrumentation devices, systems, and supporting equipment for human experiments. Development of flight experiment hardware and supporting ground test equipment including definition, systems engineering and analysis, hardware fabrication and acceptance testing. Systems include sensing instruments, control, and data in support of in-flight biomedical monitoring of human status and performance. Areas of interest include flight experiment microcomputers; non-invasive physiological monitoring, respiratory gas analysis via mass spectrometry; data storage and recording; biomedical telemetry; auto test and checkout systems; ground support facility development and specialized support equipment.

Flight Crew Support Division **JS12**

Human-machine interface requirements definition, systems engineering, analyses and integration for development and operation of human-systems for space flight and planetary habitats. Areas of interest include Advanced Food Technology, flight crew equipment development and provisioning including clothing, restraints, mobility aids, personal hygiene, emergency survival techniques, housekeeping in reduced and microgravity, long mission systems development for clothes washing, personal hygiene, modified integrated logistics support techniques for small critical systems, advanced technologies for microgravity and 1-g human-machine interfaces; computerized dynamic, anthropometrically accurate, human-modeling; control of remote operations/human interfaces to automated systems; human-computer interaction research; system information management; habitability subsystems and protocols; biomechanics data collection and human modeling advanced ADP technologies and applications, and high resolution digital image acquisition/storage/transmission/reproduction.

Medical Sciences Division **JS13**

Evaluation of bone demineralization, muscle atrophy, and cardiovascular deconditioning resulting from space flight; astronaut radiological health assessment; prevention of decompression sickness following pressure changes, biotechnology and cell culture in space; hormonal regulation of fluid and electrolyte balance; pharmacokinetics in space; nutritional biochemistry; muscle cell physiology; toxicological assessment of spacecraft environment; microbiological capability in space; physiological correlates of space adaption syndrome; clinical characterization of space motion sickness (SMS); vestibulomotor and vestibulocular mechanism in SMS; behavioral, physiological and pharmacological countermeasures; development of capabilities for in-flight health care, physical exercise, and spacecraft environmental monitoring.

Earth Science and Solar Exploration Division **JS14**

Fundamental research on the composition, origin, and evolution of terrestrial planets, meteorites, and interplanetary dust through chemical, mineralogical, and isotopic analysis of extraterrestrial materials utilizing state-of-the art analytical instrumentation and through laboratory simulation of natural melting and impact processes using high-pressure, high-temperature furnaces and hypervelocity impact facility. Cooperative studies of energy expenditures in humans using mass spectrometers. Lunar base science and lunar and Mars resource utilization studies. Definition of future human planetary missions. Applied research into the

characteristics of the near-Earth space environment, including measuring and modeling the distribution, rate of growth, hazards, and mitigation of debris in Earth orbit; hydrocode modeling of debris impact; experimental and hydrocode modeling studies of hypervelocity impacts onto spacecraft components; analysis of impacts on space-exposed surfaces; and measurement and modeling of the space radiation environment. Engineering analysis of photography and television of Shuttle and Space Station. Study of environmental, geological, oceanographic, meteorological processes as revealed in photography from Shuttle.

Space Station Program Office

Vehicle Office **JS15**

The EEE Parts Information Management System (EPIMS) is no longer the data base of choice since NASA HQ stopped development funds and the EPIMS Administrator is now supporting GSFC-funded data base developments and priorities. After coordinating with the EPIMS Administrator, it was agreed that the ISS Program Office should develop its own parts management system. GSFC is now developing a new "Parts-Web" data base which currently does not have all the capabilities to support the ISS EEE Parts need.

With the aid of the Summer Faculty Fellowship Program and support from the University of Houston, the Parts Control Board has developed a prototype data base in Microsoft Access which has been dubbed "Polaris." This system will be used in the short term to complete the launch package assessments. In addition, the EEE parts organization is working with the Engineering Data Management personnel to determine if VMBD capabilities can be developed to support long-term goals.

Kennedy Space Center (KSC)

Artificial Intelligence /Expert Systems **KS01**

The development of knowledge-based systems for a variety of ground processing and management functions. Specific interest exists in real-time control and monitoring, automated test procedure development, imbedded diagnostics, fault isolation, and management planning and scheduling applications.

Robotics **KS02**

The application of current and advanced robotics technology to time critical, hazardous or repetitive labor intensive operations. Specific interest exists in high-speed vision, precise positioning, force-torque tracking, counter balancing, adaptive control software, and redundancy. Application under study or development include: remotely controlled umbilicals; inspection and re-waterproofing of orbiter tiles; inspection of orbiter radiator panels; inspection of payloads; and cleaning of payload canisters.

Computer Science **KS03**

Research and development includes real-time systems for control and monitoring of complex check-out and launch procedures. Distributed data bases and computer networking techniques and various microprocessor applications in work and human-computer interface techniques are under investigation. Major efforts include the development processing systems specifically designed for use at KSC.

Communication/Fiber Optics **KS04**

Continued work with multi- and single-mode optical fibers exists as well as development activities in optical multiplexing, switching, repeaters, and various fiber optic instrumentation techniques. Applications for research also include high speed

baseband and broadband communications in the integrated networking environment and high reliability/redundant dedicated circuits.

Communications/Networks **KS05**

Research, development, and evaluation of leading edge network architectures, network operating systems, and network protocols. These would be for local area networks (LAN), metropolitan area networks (MAN), wide area networks (WAN) and the Internet. Focus study or analysis would include reduction of implementation and operating costs of existing systems, system expansions, and new systems. This is to be accomplished through the application of new technology, new techniques and consolidation of systems.

Instrumentation and Hazardous Gas Monitoring **KS06**

Numerous advanced technology projects include hydrazine sensing, mass spectrometry contamination monitors, personnel dosimeters, gas monitors and warning equipment for trace levels of several toxic elements. Other instrumentation projects involve level and flow measurement of cryogenic propellants, new transducers, and state-of-the-art fire detectors.

Fluids **KS07**

Tasks underway involve cryogenic vacuum-jacketed storage, perlite compaction, hypergol vapor dispersion down draft elimination, low-cost cryogenic transfer pipelines, slush hydrogen transfer pipelines, magnetic refrigeration for air conditioning, two-phase fluid flow meters, self-contained atmospheric protection ensemble breathing air management systems, hypergol discharge elimination and hypergol vapor scrubber improvement.

Computer-Aided Engineering **KS08**

Development of analytical and graphic techniques to improve engineering tasks associated with modeling and reporting results from analysis and laboratory tests dealing with dynamic loads, cryogenic two-phase flow and heat transfer, and structural, mechanical and electronic systems.

Atmospheric Science **KS09**

KSC is interested in predicting severe weather and thunderstorms. Instrumentation is in place and under development to track thunderstorms based on electromagnetic and electrostatic characteristics. Opportunities exist in studying the physics of lightning processes, in characterization of electromagnetic emission associated with lightning, and in the development and implementation of improved lightning protection techniques. Opportunities also exist for the development of operationally viable techniques for measuring (not merely inferring) charge and/or electric fields in and around clouds. Remote sensing techniques are preferred for operational reasons, but cost-effective in-situ measurements which do not interfere with or pose a hazard to launch operations would also be acceptable.

Life Sciences **KS10**

Continuation of a project to demonstrate the feasibility of using bioregenerative systems to recycle critical elements of human life support. Initial tasks employ a closed chamber to verify varieties of plants in communities for the production of edible biomass and respirable oxygen, and to recover water; and bioreactors to recover plant and human waste solids, fluids, and metabolic gases. Application of AI/Expert systems, robotics and instrumentation to this project is appropriate. Other allied

research tasks deal with chemical and microbial contaminate characterization, removal, and control for habitable structures in the space environment; the influence that gravity may have on plant growth, metabolism, and production; and in the preservation of human health for long-duration missions.

Material Science **KS11**

A number of tasks are underway investigating corrosion preventative coatings to include electrically conducting polymers, accelerated corrosion test techniques, thermal protective coatings, material ignitability in high pressure oxygen, and cholorofluorocarbon replacement chemicals and mechanical cleaning techniques.

Industrial/Business Management **KS12**

Development models and measures for cost-effective application of information technology to shuttle processing.

Industrial Engineering **KS13**

The development of industrial engineering tools for supporting efforts to improve Shuttle processing efficiency and effectiveness. Specific areas of interest include: human factors engineering, work measurement and methods analysis, process modeling and analysis (including simulation, probabilistic risk analysis and decision analysis), and benchmarking.

Systems Safety **KS14**

Perform research in the identification and control of hazards, probabilistic risk assessment, fault-tree analysis and applications, interactive hazard information tracking and closure systems, and reliability engineering.

Quality Engineering **KS15**

Perform research in the application of statistical process control, methods and analysis, automated assessment techniques and evaluation of inspection methods.

Flight Hardware Evaluation **KS16**

Activities would involve verification testing of space flight hardware in support of life sciences research in space. The hardware is to be evaluated as to providing an appropriate environment for the experimental organism within the mass, size and power constraints of a Space Shuttle middeck locker. The tasks involve ground-based biological verification of the appropriateness of the hardware as a research tool.

Life Sciences Educational Programs **KS17**

An evaluation of the Life Sciences Educational Programs is required to establish efficacy of the activities involved. A simple instrument and the means for compiling this data needs to be developed in which the participants in the event (students, teachers, and the public) can respond as to the impact of the event. The concerns-Based Adoption Model is an example of a model to measure the efficacy of teacher training. Creation of this evaluation scheme will include the development of instruments such as surveys, questionnaires, interview guidelines, and tests. The instruments must also be pilot-tested and evaluated as to their content validity and situational usefulness. Other tasks would be to develop curriculum enhancements to the current programs and improved means for coordinating and implementing existing programs.

Real-Time Control Systems **KS18**

Research and development of hardware/software used in real-time control systems from embedded applications to critical large scale distributed systems. Applications under study or development include: control system for real-time digital video distribution system; control system for a checkout of space vehicles payloads; real-time

voice communications systems; real-time monitor and analysis system for flight hardware technology demonstrator; development of rough logic algorithm for training of neural nets; development of RF collision detect wireless data network.

Industrial Engineering **KS19**

The developmental of industrial engineering technologies for supporting efforts to improve the efficiency and effectiveness of spacecraft processing. Areas of interest include: operations research, process simulation modeling, statistical process control, data mining, experimental design, planning and scheduling systems, project management risk analysis, cost benefit analysis, methods engineering, work measurement, human factors, ergonomics, facility layout/design, incident analysis, performance metrics, management information systems, and bench marking.

Langley Research Center (LaRC)

Atmospheric Sciences Program **LA01**

Apply LaRC's capabilities to expand the scientific understanding of the Earth's stratosphere and troposphere and develop the ability to assess potential threats to the atmosphere.

Climate Research Program **LA02**

Theoretical, laboratory, and field investigations of the chemical and radiative properties of natural and human-made aerosols and assessment of their impact on regional and global climate. Remote and in-situ observations of the cloud properties and radiation balance components and theoretical studies.

Communication Technology **LA03**

Dissemination tools for promoting the expedient transfer of technologies over Internet (World Wide Web) and commercial object-oriented electronic distribution models and methodologies.

Computer Science **LA04**

Concurrent processing, highly reliable computing, information and data base management, software engineering, software safety, and application of formal methods to systems design and analysis.

Controls and Guidance **LA05**

Fault tolerant systems, aerospace vehicle dynamics and applied control concepts.

Design for Competitive Advantage **LA06**

A major problem facing the aerospace industry is how to become more competitive. Decreased cost and increased quality characterize the increased value necessary to improve competitive advantage. This task is to concurrently examine, in the context of competitive advantage, (1) an aerospace product and (2) the system by which we bring forth, sustain, and retire that aerospace product.

Electromagnetic Systems **LA07**

Electromagnetic analysis methods, far-field and near-field antenna measurements and analysis, High Intensity Radiated Fields, compact range applications, aircraft and spacecraft antenna systems, and computational electromagnetics.

Electronics and Information Systems **LA08**

Microwave-sensing technology, laser-sensing technology, optical data processing, and very high speed information processing.

Engineering Lab Team **LA09**

Physical and chemical analytical testing services needed for the operation of facilities at LaRC. Development of analytical instrumentation that will advance services at LaRC or will advance technology in aeronautics and space projects. Current projects include instrumentation for environmental control, X-ray fluorescent spectroscopy for wear metal, agriculture and geological analysis, flow field and temperature visualization for wind tunnel models and high temperature superconductive materials for magnetic levitation.

Facility Assurance **LA10**

Systems safety and risk management techniques applied to unique wind tunnel facilities and operations.

Facility Engineering **LA11**

Engineering and design of research facilities and equipment for aeronautical and space research, including wind-tunnel structures and systems, test selections, model support, environmental chambers, heaters, coolers, mechanical drives, electrical drive machinery, and electrical distribution systems.

Flight Electronics Technology **LA12**

Research covering flight electronic system sensing, computing, and display for aerospace applications. Flight system sensing includes laser sensing, microwave remote sensing technology including electromagnetic analysis methods, far-field and near-field antenna measurements, compact range technology, and aircraft and spacecraft antenna technology. Computer technology and data processing research areas include optical data processing, solid-state memory technology, very-high-speed information processing, concurrent processing, and highly reliable and fault-tolerant systems.

Gas Dynamics **LA13**

Opportunities for research in both focused and basic research and technology development in the areas of aerothermodynamics and hypersonic airbreathing propulsion. Develop, validate, and perform analytical, computational and experimental aerodynamic, aerothermodynamic and fluid physics research to develop, optimize, and evaluate future experimental flight demonstration vehicles and aerospace vehicles.

Flight Deck System **LA14**

Flight deck design, flight management technology, systems management concepts, flight deck automation/integration, and aviation safety.

Fluid Physics **LA15**

Subsonic aerodynamics, transonic aerodynamics, high speed aerodynamics, computational fluid dynamics, turbulent drag and noise reduction, airfoil aerodynamics, advanced test instrumentation, full scale Reynolds number test technology, applied mathematics and computer science.

General Aviation **LA16**

Aerodynamics, crash dynamics, integrated design and manufacturing, propeller noise reduction, avionics, single pilot IFR systems, systems interaction, and AGATE-related research.

High Speed Aircraft **LA17**

Flight dynamics, advanced military aircraft and missiles, high speed transportation, supersonic laminar flow and single-stage-to-orbit vehicles.

Hypersonic Fluid Physics **LA18**

Launch vehicle and spacecraft aerothermodynamics and configuration technology; and aerodynamic and aerothermodynamic flight data analysis.

Low Speed Aircraft **LA19**

Rotorcraft structures, vibrations, aeroelasticity and acoustics, natural laminar flow, and landing dynamics.

Materials and Structure **LA20**

Structural composites and adhesives, materials for advanced aircraft and spacecraft structures, loads, aeroelasticity and structural dynamics, high temperature aerospace structures and thermal protection system materials, advanced space structures, design methods, and space vehicle dynamics, nondestructive evaluation, computational structural mechanics, and fatigue and fracture mechanics.

Propulsion **LA21**

Noise research, propulsion integration, hypersonic airbreathing propulsion research, advanced turboprops.

Spacecraft Systems and Transportation Systems Technology **LA22**

Space structures systems technology, File II flight experiment, semiconductor materials growth in low G environment, computer-aided design, future space vehicle concept development, operations research, integrated systems design, and advanced launch systems.

Systems Engineering and Systems Analysis **LA23**

Mathematical modeling, optimization, parametric studies and cost estimation of various aeronautics and space engineering systems.

System Genopersistation Technology **LA24**

Develop technology for the genopersistation of systems, that is, technology for accomplishing the functions: conceptually design; develop; test and evaluate; produce; deploy; operate; support; evolve; retire; and manage. Emphasis is to be placed on how NASA and its support community can accomplish these functions faster, better, and with less resource utilization.

Technology Transfer/ Commercialization **LA25**

Transfer of LaRC-developed technologies to American companies/industries, with emphasis on non-aerospace applications, but team members will also help researchers transfer technologies that only have aerospace applications.

Transport Aircraft **LA26**

Wake vortex minimization, laminar flow control, high Reynolds number research, configuration aerodynamics, advanced guidance and control, flight management research, noise reduction, and automation of air traffic surface operations.

Transportation Systems **LA27**

Future space vehicle concept development, operations, research, and computer-aided design.

Lewis Research Center (LeRC)

Aeronautical Propulsion **LE01**

Rotorcraft, subsonic, supersonic, and hypersonic propulsion systems and components; aerodynamics and acoustics of turbomachinery; aerodynamics of inlets and nozzles; fundamentals of internal combustion; small engine propulsion technology; aircraft icing.

Propulsion Systems Analysis **LE02**

Propulsion system and aircraft modeling, integration analysis, novel concepts, mission studies, configuration studies, and environmental/economic assessments.

Computer Science **LE03**

Numerical analyses including nonlinear regression, acceleration of series or sequences of scalars and vectors, symbolic manipulation, modularized algorithms, client/server architectures, graphical user interface design and development.

Data Management **LE04**

Acquisition of experimental data, data base structure and searching, management information systems.

Instrumentation and Control **LE05**

Advanced instrumentation for propulsion research including thin-film sensors and remote-sensing optical-based systems, advanced propulsion and flight controls emphasizing integrated and fault-tolerant controls and fiber optic-based control systems, high temperature integrated electronics and sensors based on SiC technology.

Internal Fluid Mechanics and Heat Transfer **LE06**

Advanced numerical methods, multiblock grid and zonal approaches, 3-D geometry and mesh-generation techniques, prediction of 3-D turbulent flow fields, application of advanced computer concepts and expert systems, fluid mechanics of inlets and nozzles, aerothermodynamics of combustors and augmentors, fan and compressor aerodynamics, flow and heat transfer in turbines, unsteady aerodynamics.

Materials **LE07**

Metallic materials and advanced processing methods, ceramic and ceramic matrix composites, polymer and metal matrix composites, fundamental studies in tribology.

Microgravity Experiments **LE08**

Combustion, materials processing, crystal growth, fluid physics, theoretical modeling.

Space Communication **LE09**

Microwave amplifiers, solid-state devices, circuit technology, RF systems, digital systems, advanced antenna technology.

Space Power **LE10**

Photovoltaics, electrochemical energy storage, solar dynamic power systems, power electronic systems and devices, electrophysics, power management and distribution systems, power systems dynamics and control, environmental interactions.

Space Propulsion **LE11**

Primary and auxiliary chemical rockets; ion, resistojet and arcjet electronic propulsion; rocket engine health management, expendable launch vehicle upgrades.

Space Systems Engineering **LE12**

Space Station power system, advanced communication satellite (ACTS).

Structures **LE13**

Analysis and design methodology of metallic and composite engine structures, advanced structural mechanics, nondestructive evaluation, fatigue, fracture and life prediction, aeroelasticity and structural dynamics, rotor dynamics.

Marshall Space Flight Center (MSFC)

Space Sciences **MA01**

Gamma ray, x-ray astronomy, cosmic ray, low temperature, solar, atomic, magnetospheric, and space plasma physics; aeronomy; superconductivity.

Earth Science **MA02**

Storm physics; geophysical fluid dynamics; atmospheric processes, dynamics and composition; remote-sensing including laser Doppler and visible/infrared devices.

Computer Science **MA03**

Supercomputer systems optimization; distributed data management, Management Information Systems (MIS).

Microgravity Science **MA04**

Containerless processing, crystal growth, solidification phenomena, separation techniques, fluid modeling, protein crystal growth, optical techniques, solid-state structure and property characterization.

Materials and Processes **MA05**

Engineering physics, advanced NDE techniques, atomic oxygen effects, turbopump bearings, space lubricants, metallic materials, non-metallic materials, composites, propellants, processes engineering, robotics welding, welding process, vacuum plasma spray technology.

Structures **MA06**

Structural design optimization of isotropic and anisotropic space structures and elements, orbital (debris/meteoroid) protection systems, stress analyses, fracture mechanics, fatigue, durability, structural test methods.

Dynamics **MA07**

Rotordynamics, pointing and vehicular control systems design, large flexible space structures dynamics, vibroacoustics response, loads analyses, design criteria and verification methods, computational fluid dynamics, rarefied gas dynamics, fluid-elastic instabilities.

Propulsion **MA08**

Propulsion concepts for advanced space exploration, propulsion systems analysis, zero and low gravity fluid management, solid rocket motor technology development, hybrid propulsion technology development, combustion stability analysis, health management, reliability, turbo-machinery performance, cryogenic bearing design, engine ignition and transient analysis, combustion analysis, spray combustion experiments, combustion diagnostics, automated control systems, rocket engine testing, and digital/analog data acquisition systems.

Thermal Control and Life Support **MA09**

Closed loop life support analysis/integration/testing, heat pipes/two-phase flow analysis and modeling, avionics cooling, low temperature control/refrigeration development, passive thermal protection concepts and thermal vacuum testing techniques.

Information and Electronic Systems/Avionics **MA10**

Electrical systems, electrical power systems and components, solar power, high-rate and high-density data acquisition, audio and video systems, radio frequency and laser communication, lidar, antenna systems, flight computers and related ground support equipment, flight electronic packaging, life-cycle software engineering, math models, system and subsystem flight simulations, software development and management, fault tolerant logic systems, electronic device failure analysis techniques, optical instruments and systems, optical metrology, optical fabrication, and photographic processes.

Automation and Robotics **MA11**

Automation techniques (all Avionics disciplines), knowledge-based AI/Expert Systems development and implementation, robotics, telerobotics, and robotics system simulations.

System Analysis and Integration **MA12**

Systems engineering, systems analysis, systems design, integration/verification, orbital mechanics, optimization, trajectory optimization, mission design, guidance schemes, navigation methods, EMC/EMI analyses and modeling, Space Station support for lunar base/Mars mission, and configuration management techniques.

Systems Safety Engineering **MA13**

Hazard identification and control, probabilistic risk assessment, fault-tree analysis, interactive hazard information tracking. Automated assessment techniques, reliability engineering, statistical modeling, failure mode analysis.

Quality Engineering **MA14**

Application of quality function deployment, design of experiments for process characterization, program quality cost studies, application of statistical process control methods.

Testing and Experimentation **MA15**

Non-destructive evaluation of structures under dynamic loads, holographic and optical techniques, experimental astrophysics, vacuum system design.

Advanced Mission Studies **MA16**

Conceptual design of advanced launch and orbital vehicles, large optical systems, laser power beaming, geostationary facilities, crewed lunar and Mars missions, and scientific spacecraft.

Mission Operations **MA17**

Resource analysis, operations planning and integration, flight systems operations, data management, crew procedures, human/systems integration, mission design, ground control systems design, development and operation, communications systems, training systems design, development and operations, flight and ground crew training, human-systems development and development of analytical tools such as virtual reality.

Stennis Space Center (SSC)

Propulsion Systems Testing Techniques **ST01**

A flexible, dynamic fluid flow simulation and structural modeling graphic interface research tool is desirable for ground test programs of space propulsion systems. An effort is ongoing to develop an Engine Testing Facility Model which can run real-time prior to testing and during testing of an engine component.

Cryogenic Instrumentation **ST02**

Instrumentation is needed to precisely measure mass flow of cryogen from very low flow rates to very high flow rates at pressures to 15,000 psia. Research, technology, and development opportunities exist in developing instruments to measure fluid properties at cryogenic conditions during ground testing of space propulsion systems. Research technology and development opportunities also exist for instrumentation and methods of strain measurement at cryogenic temperatures.

Non-Destructive Test and Evaluation **ST03**

Advanced instrumentation, methods, and techniques to conduct advanced non-destructive test and evaluation, failure analysis, and purity and cleanliness assessment are desired for the entire system to component levels. Research opportunities exist in acoustic emission, ultrasonics, high energy radiography in the non-destructive test and evaluation laboratory.

Exhaust Plume Diagnosis **ST04**

Research opportunities are available to quantify failure and wear and related plume code validation through vehicle health management/exhaust plume diagnostics experimentation. Exploratory studies are being conducted with emission/absorption spectroscopy, absorption resonance spectroscopy, and laser-induced fluorescence.

Non-Intrusive Remote-Sensing **ST05**

Future propulsion system test techniques could employ non-intrusive sensors for acquiring measurements over wide areas instead of contact, intrusive sensors at a few discrete points. Opportunities exist in temperature, pressure, stress, strain, position, vibration, shock, impact, and other measured test parameters. The use of thermal infrared, ultraviolet, and multi-spectral sensors, imagers, and instruments is possible through the SSC sensor laboratory.

Thermal Protection and Insulation Systems **ST06**

The test of liquid rocket systems employ very large flame buckets and diffusers to control, deflect, cool, condition, and reduce the sound level of the plume. Innovative thermal protection tiles, coating, or materials, and insulation systems could result in significant savings.

Propellant and Pressurants Conservation **ST07**

Large quantities of cryogenic fluids are used to bring propulsion systems and the test facility complexes from ambient temperatures to several hundred degrees Fahrenheit below zero. Research into operations techniques, recovery facilities and equipment, and energy management and conservation could likely improve ground testing to save money and energy.

Leak Detection **ST08**

Opportunities exist in hazardous (e.g., hydrogen) and non-hazardous leak detection technology to determine what is leaking, how much is leaking, where is the source of the leak, and how to model and visualize the extent of the effected area.

High Pressure/High Temperature Systems Studies **ST09**

Supersonic research aircraft will require technological advances in actively cooled and passive insulating materials for vehicle airframe and propulsion system components. Testing of these materials at SSC offers research opportunities in heat transfer, hot hydrogen, seal technology, thermal stresses, metal creep, and evaluation of materials after long duration exposure to high temperature and high acoustic energy.

Earth Science **ST10**

Basic and applied research related to biological, chemical, geological, and physical processes occurring within the coastal environment (land and ocean) and their interactions. Emphasis on the use of remotely-sensed data to examine relevant processes over a broad range of temporal and spatial scales as well as man's impact on the environment. Current research disciplines include archaeology, anthropology, botany, forestry, oceanography, plant physiology, and soil science. Tools include ground-based imaging spectrometers and airborne and satellite radiometers.

Remote-Sensing Technology **ST11**

The design and development of low-cost alternatives for multispectral imaging of Earth processes especially those related to coastal environments. Design and coding of innovative image processing tools related to Earth system science such as data visualization, archiving, and feature extraction.

Science Education **ST12**

The goal is to develop laboratory exercises and other curriculum support material that involve the incorporation of images acquired by Earth-observing satellites into college-level (freshman and sophomore) science courses. Exercises will be computer-implemented and posted on a web site. Each lab exercise will integrate text, graphics, and images to focus on a science issue covered by the particular course for which one or two periods can be allocated.

Appendix B

NRA 96-OEOP-1

NFSD 89-0 (JUNE 30, 1989)

PART 18-70

NASA SUPPLEMENTARY REGULATIONS

8-70-203, App. I

Guidelines For Responding To NASA Research Announcements For Solicited Basic Research Proposals. (NASA Office Of Procurement, August 1988)

1. Foreword

NASA depends upon industry, educational institutions, and other nonprofit organizations for most of its research efforts. While a number of mechanisms have been developed over the years to inform the research community of those areas in which NASA has special research interests, these instructions apply only to "NASA Research Announcements," a form of "broad agency announcement" described in 6.102(d)(2) and 35.016 of the Federal Acquisition Regulation (FAR). The "NASA Research Announcement (NRA)" permits competitive selection of research projects in accordance with statute while at the same time preserving the traditional concepts and understandings associated with NASA sponsorship of research.

These instructions are Appendix I to 18-70.203 of the NASA Federal Acquisition Regulation Supplement.

2. Policy

NASA fosters and encourages the submission of research proposals relevant to Agency mission requirements by solicitations, "NASA Research Announcements," which describe research areas of interest to NASA. Proposals received in response to an NRA will be used only for evaluation purposes.

NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA, to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

3. Purpose

These instructions are intended to supplement documents identified as "NASA Research Announcements." The NRA's contain programmatic information and certain "NRA-specific" requirements which apply only to proposals prepared in response to

that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRA's.

4. Relationship To Award

A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded on the basis of a proposal submitted in response to an NRA. NASA does not have separate "grant proposal" and "contract proposal" categories, so all proposals may be prepared in a similar fashion. NASA will determine the appropriate instrument.

Grants are generally used to fund basic research in educational and nonprofit institutions, while research in other private sector organizations is accomplished under contract. Additional information peculiar to the contractual process (certifications, cost and pricing data, facilities information, etc.) will be requested, as necessary, as the procurement progresses. Contracts resulting from NRA's are subject to the Federal Acquisition Regulation and the NASA FAR Supplement (NHB 5100.4). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the Research Grant Handbook (NHB 5800.1C).

5. Conformance To Guidance

NASA does not have any mandatory forms or formats for preparation of responses to NRA's; however, it is requested that proposals conform to the procedural and submission guidelines covered in these instructions. In particular, NASA may accept proposals without discussion; hence proposals should initially be as complete as possible, and be submitted on the proposers' most favorable terms.

In order to be considered responsive to the solicitation, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation. NASA reserves the right to reject any or all proposals received in response to an NRA when such action is considered in the best interest of the government.

6. NRA-Specific Items

Several proposal submission items will appear in the NRA itself. These include: the unique NRA identifier, when to submit proposals; where to send proposals; number of copies required; and sources for more information.

Items included in these instructions may be supplemented by the NRA, as circumstances warrant. Examples are: technical points for special emphasis; additional evaluation factors; and proposal length.

7. Proposal Contents

The following general information is needed in all proposals in order to permit consideration in an objective manner. NRA's will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter, if it contains substantive information.

7.1 Transmittal Letter or Prefatory Material

a. The legal name and address of the organization and specific division or campus identification if part of a larger organization;
b. A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;
c. Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;
d. Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
e. Identification of any other organizations that are currently evaluating a proposal for the same efforts;
f. Identification of the specific NRA, by number and title, to which the proposal is responding;
g. Dollar amount requested of NASA, desired starting date, and duration of project;
h. Date of submission; and
i. Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

7.2 Restriction on Use and Disclosure of Proposal Information

It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE: Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and / or information that is commercial or financial and confidential or privileged. It is furnished to the government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal, the government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the government's right to use or disclose this information (data) if obtained from another source without restriction.

7.3 Abstract

Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective of the proposed effort and the method of approach.

7.4 Project Description

The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge in the field; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken and an adequate description of experimental methods and procedures. The project description should be prepared in a manner that addresses the evaluation factors in these instructions and any additional specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Note, however, that subcontracting significant portions of a research project is discouraged.

When it is expected that the effort will require more than 1 year for completion, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should, of course, be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

7.5 Management Approach

For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and any necessary arrangements for ensuring a coordinated effort should be described. Aspects of any required intensive working relations with NASA Installations and/or the Jet Propulsion Laboratory that are not logical inclusions elsewhere in the proposal should be described in this section.

7.6 Personnel

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included.

Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

7.7 Facilities and Equipment

Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project.

Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state.

The need for items that typically can be used for both research and non-research purposes should be explained.

7.8 Proposed Costs

Proposals should contain cost and technical parts in one volume; do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all manpower data in terms of man-months or fractions of full-time.

Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases (Standard Form 1411 may be used).

Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 18-31 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

7.9 Security

Proposals should not contain security classified material. However, if the proposed research requires access to or may generate security classified information, the submitter will be required to comply with applicable government security regulations.

7.10 Current Support

For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current government-wide guidelines.

Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant government audit agency, inspection agency, and administrative contracting officer, when applicable.

8. Renewal Proposals

Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. It is not necessary that a renewal proposal repeat all of the information that was in the original proposal upon which the current support was based. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered

during the period for which extended support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

NASA reserves the right to renew an effort either through amendment of an existing contract/grant or by a new award.

9. Length

Unless otherwise specified in the NRA, every effort should be made to keep proposals as brief as possible, concentrating on substantive material essential for a complete understanding of the project. Experience shows that few proposals need to exceed 15-20 pages. Any necessary detailed information, such as reprints, should be included as attachments rather than in the main body of the proposal. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments; their availability may be mentioned in the proposal.

10. Joint Proposals

Some projects involve joint efforts among individuals in different organizations or mutual efforts of more than one organization. Where multiple organizations are involved, the proposal may be submitted by only one of them. In this event, it should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

Where a project of a cooperative nature with NASA is contemplated, the proposal should describe the contributions expected from any participating NASA investigator and Agency facilities or equipment which may be required. However, the proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which purport to specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an Agency commitment.

11. Late Proposals

A proposal or modification thereto received after the date or dates specified in an NRA may still be considered if the selecting official deems it to offer NASA a significant technical advantage or cost reduction.

12. Withdrawal

Proposals may be withdrawn by the proposer at any time. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

13. Evaluation Factors

Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

a. Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission and the production of U.S. citizens in NASA-related fields.

b. Evaluation of its intrinsic merit includes the consideration of the following factors, none of which is more important than any other.

c. Evaluation of the cost of a proposed effort includes the consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds:

(1) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(2) The offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(3) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel who are critical in achieving the proposal objectives.

(4) Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.

14. Evaluation Techniques

Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases, however, proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house where NASA has particular competence; others are evaluated by a combination of in-house people and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. Regardless of the technique, the final decisions are always made by a designated NASA selecting official. A proposal which is scientifically and programmatically meritorious, but which is not selected for award during its initial review under the NRA, may be included in subsequent reviews unless the proposer requests otherwise.

15. Selection For Award

When a proposal is not selected for award, and the proposer has indicated that the proposal is not to be held over for subsequent reviews, the proposer will be notified that the proposal was not selected for award. NASA will notify the proposer and explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will manage a debriefing.

When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation with fee submitter. Formal RFP's are not used to obtain additional information on a proposal selected under the NRA process. However, the contracting officer may request certain business data and may forward a model contract and other information which will be of use during the contract negotiation.

16. Cancellation of NRA

NASA reserves the right to make no awards under this NRA and, in the absence of program funding or for any other reason, to cancel this NRA by having a notice published in the Commerce Business Daily. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation. Cancellation may be followed by issuance and synopsis of a revised NRA, since amendment of an NRA is normally not permitted.

Appendix C

Required Forms

FORM C-1

FAR Proposal Cover Page

This Box for NASA Use Only			
	Proposal Number		Date Received
Name of Submitting Institution		**Congressional District**	
Proposal Title			
Principal Investigator - Name		Authorized Institutional Official - Name	
Title		Title	
Department		Department	
Mailing Address		Mailing Address	
Telephone Number		Telephone Number	
Fax Number		Fax Number	
E-mail Address		E-mail Address	
Principal Investigator - Signature		Authorized Institutional Official - Signature	
Date		Date	

Insert topic code associated with proposed research area (see Appendix A)

	Ames Research Center		Jet Propulsion Laboratory
	Goddard Space Flight Center		Dryden Flight Research Center
	Kennedy Space Center		Stennis Space Center
	Langley Research Center		Johnson Space Center
	Lewis Research Center		Marshall Space Flight Center

FORM C-2

FAR 1998

Certification of Institution and Principal Investigator Eligibility

Submit one copy of this form with the original proposal.
Do not include this form with any of the other copies, as this may compromise the confidentiality of the information.
Completion of this form is required.

I. Institutional Eligibility Certification

1. Institution Name _____
Proposal
Title_____
_____

3. Identify Highest degree offered (e.g., MS, or Ph.D) by the institution in Mathematics, Science or Engineering
Major_____Highest Degree_____
Major_____Highest Degree_____
Major_____Highest Degree_____

4. Check each of the Department of Education FY 1996 certifications held by the institution.
___ Minority Institution (underrepresented minority group(s) exceed 50% of the total student enrollment)
___ Designated Hispanic-Serving Institute
___ Designated Historically Black College or University
Note: Institutional eligibility will be verified by data on enrollments.

II. Principal Investigator Eligibility Certification

1. Last Name First Name MI

2. Verification of Employment:

Employed by (institution):

School / Department (specify):

Check type of position
___ Tenured ___ Tenured-track ___ Contractual

3. U.S. Citizen ☐ Yes ☐ No (citizenship will be verified at award time)

4. Is Principal Investigator a recipient of a Ph.D. degree?
___ yes ___ no
If yes, specify area: engineering, mathematics, science
_____
_____
_____
_____

Form C-2 (continued)

III. Previous NASA Funding

1. List all NASA awards, NASA contracts, NASA consulting from which the proposed PI received funding as PI or CO-I during the past 5 years, including active awards.

ColumnA	Column B	Column C	Column D	Column E
Award	PI or CO-I	Title of Award	Period (from - to)	Amount
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			/ / to / /	
			TOTAL FUNDING:	

Instructions:

Column A: Identify whether award was a research grant (R), education grant (E), contract (C), or consulting agreement (A).

Column B: For each award indicate whether applicant was a PI or CO-I.

Column C: List title of award.

Column D: List the period of performance**.**

Column E: List amount of award. For awards on which the proposed PI was a CO-I, show only that portion of the award which supported the proposed PI's personal research, and attach an explanation of how this was determined. For awards on which the proposed PI was the PI, show the total award amount.

Certification Authority

The person authorized to sign below certifies that the information provided is accurate.

Authorized Institutional Official

Typed Name _____

Title_____
Authorized Institutional Official Signature

_____

FORM C-3

FAR 1998

Supplementary Information Report

Submit one copy of this form with the original proposal. Do not include this form with any of the other copies, as this may compromise the confidentiality of the information. Completion of this form is voluntary. Please check the appropriate answers to each question for the principal investigator. Any individual not wishing to provide the information should check the space provided.

___ No, I prefer not to provide this information

1. Gender ___ Female ___ Male
2. Which ONE of these categories best describes this person's ethnic / racial status?
   (If more than one applies, use the category that most closely reflects the person's recognition in the community.)

___ American Indian or Alaskan Native ___ Black, not of Hispanic Origin

___ Asian ___ Pacific Islander

___ Hispanic ___ White, not of Hispanic Origin

3. Does this person have a disability* which limits a major life activity?
___ Yes ___No

Definitions

American Indian or Alaskan Native: A person having origins in any of the original peoples of North America, and who maintains cultural identification through tribal affiliation or community recognition.

Asian: A person having origins in any of the original peoples of East Asia, Southeast Asia and the Indian subcontinent. This area includes for example, China, India, Indonesia, Japan, Korea and Vietnam.

Black, not of Hispanic origin: A person having origins in any of the black racial groups of Africa.

Pacific Islander: A person having origins in any of the original peoples of Hawaii; the US Pacific Territories of Guam, American Samoa, and the North American Marianas; the U.W. Trust Territory of Palau; the islands of Micronesia and Melanesia; and the Philippines.

White, not of Hispanic origin: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

*Disabled: A person having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment or who is regarded as having such impairment. (see Back)

Why this information is being requested:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity or disability of the nominee. To gather the information needed for this important task, you should submit a single copy of this form. However, submission of the requested information is not mandatory and is not a precondition of award.

Information from this form will be retained by Federal agencies as an integral part of their Privacy Act Systems of Records in accordance with the Privacy Act of 1974. These are confidential files accessible only to appropriate Federal agency personnel and will be treated as confidential to the extent permitted by law. Data submitted will be used in accordance with criteria established by the respective Federal agency for awarding grants for research and education, and in response to Public Law 99-383 and 42 USC 1885c.

Form C-4

CERTIFICATIONS REGARDING LOBBYING; DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS; AND DRUG-FREE WORKPLACE REQUIREMENTS

Applicants should refer to the regulations cited below to determine the certification to which they are required to attest. Applicants should also review the Instructions for certification included in the regulations before completing this form. Signature of this form provides for compliance with certification requirements under 34 CFR Part 82, "New Restrictions on Lobbying," and 34 CFR Part 85, "Government-Wide Debarment and Suspension (Nonprocurement) and Government-Wide Requirements for Drug-Free Workplace (Grants)." The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Education determines to award the covered transaction, grant, or cooperative agreement.

1. LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 34 CFR Part 82, for persons entering into a grant or cooperative agreement over $100,000, as defined at 34 CFR Part 82, Sections 82.105, and 82.110, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the making of any Federal grant, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions;

(c) The undersigned shall require that the language of this certification be included in the award documents for all subaward at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts) and that all subrecipients shall certify and disclose accordingly.

2. DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

As required by Executive Order 12549, Debarment and Suspension, and implemented at 34 CFR Part 85, for prospective participants in primary covered transactions, as defined at 34 CFR Part 85, Sections 85.105 and 85.100 --

A. The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

3. DRUG-FREE WORKPLACE

(GRANTEES OTHER THAN INDIVIDUALS)

As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 --

A. The applicant certifies that it will or will continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an ongoing drug-free awareness program to inform employees about—

(1) The dangers of drug abuse in the workplace;

(2) The grantee's policy of maintaining a drug-free workplace;

(3) Any available drug counseling, rehabilitation, and employee assistance programs; and

(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will—

(1) Abide by the terms of the statement; and

(2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(e) Notifying the agency, in writing, within 10 calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W. (Room 3124, GSA Regional Office, Building No. 3), Washington, DC 20202-4571. Notice shall include the identification number(s) of each affected grant;

(f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted-

(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), ©, (d), (e), and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (street address, city, county, state, zip code)

_____

_____

Check ( ) if there are workplaces on file that are not identified here.

DRUG-FREE WORKPLACE

(grantees who are individuals)

As required by the Drug-Free Workplace Act of 1988, and implemented at 34 CFR Part 85, Subpart F, for grantees, as defined at 34 CFR Part 85, Sections 85.605 and 85.610 --

A. As a condition of the grant, I certify that I will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant; and

B. If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, I will report the conviction, in writing, within 10 calendar days of the conviction, to: Director, Grants and Contracts Service, U.S. Department of Education, 400 Maryland Avenue, S.W. (Room 3124, GSA Regional Office Building No. 3), Washington, DC 20202-4571. Notice shall include the identification number(s) of each affected grant.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above certifications.NAME OF APPLICANT

_____

PR/AWARD NUMBER AND/OR PROJECT NAME

_____

PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

SIGNATURE

DATE ED 80-0013

FORM C- 5

FAR 1998

Enrollments and Degrees Awarded Academic Year 1996-1997

Institution

Enrollments-AY 1996-97

Total Enrollment No.	U.S. Citizens (%*)	African American (%*)	Hispanic (%*)	Native American (%*)	Pacific Islanders (%*)

* % of Total Enrollment of U.S. Citizens. Note in parenthesis next to the total number, the number of individuals with disabilities i.e., 356 (7)

Degrees Awarded-Academic Year 1996-97

Degrees	Total	U.S. Citizens (%*)	African American (%*)	Hispanic (%*)	Native American (%*)	Pacific Islanders (%*)
Bachelors						
Masters						
Ph.D.'s						

Note in parenthesis next to the total number, the number of individuals with disabilities i.e., 356 (7)

FORM C-6

FAR 1998

Proposal Summary Form

1. Proposal Title:_____
2. Principal Investigator Name, Organization_____
3. Abstract of Proposed Research (200-300 words):

FAR 1998

Proposal Summary Form (continued)

4. NASA Installation individual who has expressed specific interest in this proposal (optional)

   Name_____

   Installation_____

   Telephone_____

5. Budget Summary by Federal Government Fiscal Year:

	YEAR 1	YEAR 2	YEAR 3
Requested NASA Funding			
Cost-Sharing (if applicable)			
Total Project Resources			

6. Major accomplishments planned by end of period of performance

FORM C-7

FAR 1998

Budget Request Summary

From _____to_____

	Project Total	Request to NASA	Contributions from Institution	Contributions from Others
1. Direct Labor				
a. Salaries, wages	_____	_____	_____	_____
b. Fringe Benefits	_____	_____	_____	_____
2. Other Direct Costs				
a. Subcontracts	_____	_____	_____	_____
b. Consultants	_____	_____	_____	_____
c. Equipment	_____	_____	_____	_____
d. Supplies	_____	_____	_____	_____
e. Travel	_____	_____	_____	_____
f. Communication Costs (telephone, postage, printing)	_____	_____	_____	_____
3. Indirect Costs _____%	_____	_____	_____	_____
4. Other Applicable Costs	_____	_____	_____	_____
5. Total Estimated Costs	_____	_____	_____	_____
6. Deduct Carryover Funds	XXXXXXX	--_____	XXXXXXX	XXXXXXX
7. Cost to NASA	XXXXXXX	_____	XXXXXXX	XXXXXXX

General Budget Instructions

1. Provide a separate budget form for each year of proposed research and a summary form.
2. Grantee's estimated cost should be entered in the first column. Columns two and three are for NASA use only. Column three represents the approved grant budget.
3. Provide in attachments to the budget summary the detailed computations of estimates in each cost category, along with any narrative explanation required to fully explain proposed costs.
4. General-purpose, non-technical equipment is not allowable as a direct cost to NASA grants unless specifically approved by the grant officer.
5. In connection with indirect cost provide the name, address, and telephone number of the Federal agency and official having cognizance over such matters for the institution.

Line-by-Line Instructions

1. Direct Labor (salaries, wages and fringe benefits): Attachments should list number and titles of personnel, amount of time to be devoted to the grant and hourly rates of pay.
2. Total Direct Labor Hours: Show total number of estimated labor hours required to accomplish the task.
3. Other Direct Costs:
   a. Subcontractors - Attachments should describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting this effort.
   b. Consultants - Identify consultants to be used, why they are necessary, time to be spent on the projects and rates of pay (not to exceed the equivalent of the daily rate for GS-18 in Federal service: $429 per day as of January 19, 1992, excluding, expenses and indirect cost).
   c. Equipment - List separately and explain the need for items of equipment exceeding $l,000. Describe the basis for the estimated cost.
   d. Supplies - Provide general categories of needed supplies, the method of acquisition, estimated cost, and the basis for the estimate.
   e. Travel - List proposed trips individually, describe their purpose in relation to the grant, provide dates, destination, and number of travelers where known, and explain how the cost for each was derived.
   f. Other - Enter the total of any other direct costs not covered by 3a through 3e. Attach an itemized list explaining the need for each item and the basis for the estimate.
4. Indirect Costs: Identify indirect cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. If unproved rates are used, explain why and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
5. Other Applicable Costs: Enter the total of any other applicable costs. Attach an itemized list explaining the need for each item and the basis for the estimate.
6. Subtotal — Estimate Costs: Enter the sum of items 1, 3.a, through 3.f, 4, and 5.
7. Less Proposed Cost-Sharing (if any): Enter the amount proposed if any. If cost-sharing is based on specific cost items, identify each item and amount in attachment.
8. Total Estimate Costs: Enter the total after subtracting item 7 from item 6.

Detailed Budget (Equipment List)

Item (Descriptive name, probable brand, and model)	Quantity	Unit Price	Basis	Total Cost (Discounted)	Justification

Total Equipment _____

Non-NASA Contribution:_____

Cost to NASA: _____

Use additional page(s) if needed.